THE DENTAL PRACTITIONER
AND DENTAL RECORD

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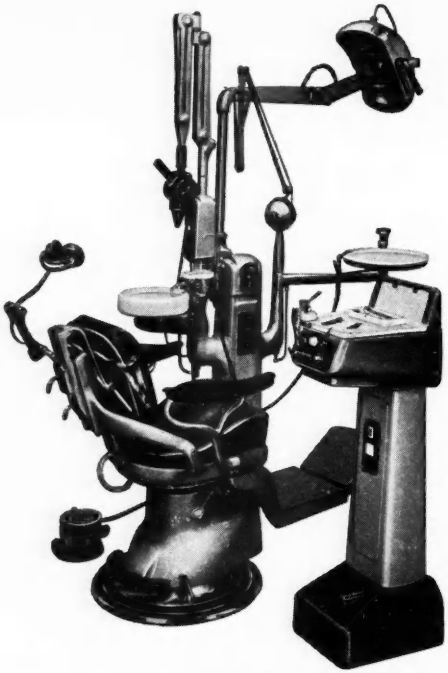

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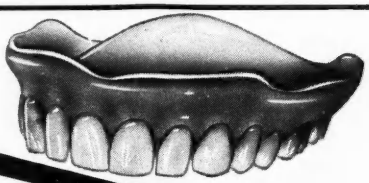

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THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. VII, No. 8 April, 1957

EDITORIAL

RADIOLOGICAL HAZARDS

THE subject of "X-radiation" is assuming larger proportions in world affairs each year, and has focused attention on many allied problems. The possible increase of further radiation, however slight, has made it clear that it is imperative to know much more about the average background of radiation received by the community, apart from atomic bombs and the present use of radio-active materials. The hazards to man from atomic and allied radiations and their effects are well known, and it is obvious that a line must be drawn between the justifiably necessary and the deleterious. Quite a large source of "background" radiation comes from the use of X-rays in diagnostic radiology. The vast majority of dental surgeons are constantly using X-rays in the diagnosis of dental lesions; indeed without the aid of dental radiology little of modern dentistry would be possible. The actual amount of radiation emitted through the use of medical and dental apparatus for diagnostic purposes is really quite unknown, and if a proper assessment of general background radiation is to be made then this question becomes of vital importance. With this in mind the Ministry of Health has set up a committee under the chairmanship of Lord Adrian to review the present practice in diagnostic radiology and the use of radio-therapy in non-malignant conditions. As a first step in their investigations, the committee is organizing a full-scale survey over the whole country to discover the amount of radiation involved in diagnostic procedures. A questionnaire is to be sent to all practising dental surgeons, to be completed during a stated period. It is in the national interest not only for the present generation, but, more important still, the future generations, that this survey is given top priority by each practitioner, and the forms completed and returned, and not dropped in the waste-paper basket. It is important that this survey is performed under perfectly normal conditions, and there should be no sudden panic to reduce the number of radiographs taken. This is not an attempt to criticize the practice of dental radiology, or even mildly to suggest that it could cause deleterious side-effects. All that is wanted is an honest assessment of the amount of radiation by dental X-ray units in use in normal diagnostic procedures. The amount of radiation in the world is apparently on the increase and it behoves us all to give our individual assistance in this grave problem. The world is surrounded by a frightening array of modern instruments. They are, however, only frightening if they are uncontrolled. To control anything first requires knowledge, and it is this knowledge that this valuable committee now seeks with your assistance and help. There is only danger in lack of knowledge, for we trust that those in authority will enforce the control once we have the knowledge.

DENTURE SORE MOUTH AND ANGULAR CHEILITIS

A PRELIMINARY INVESTIGATION INTO THEIR POSSIBLE ASSOCIATION WITH CANDIDA INFECTION

By **D. G. LYON**, F.D.S. R.C.S. (Eng.), and **A. O. CHICK**, Ph.D., M.D.S.
The University of Bristol

DENTURE SORE MOUTH

For many years a certain type of soreness under dentures has been a recurring problem to both dental and medical practitioners. It used to be referred to as "rubber sore mouth" and is to-day often erroneously diagnosed as "acrylic sensitivity". Patch tests to determine sensitivity to the denture base material are, however, nearly always negative.

Remaking the dentures occasionally improves or cures the condition, although many cases persist in spite of this and some that are initially improved by remaking the dentures relapse later, sometimes many months afterwards. If the denture base is remade in metal, however, a permanent cure is more often effected, thus confirming the rather hazy notion of sensitivity.

The possibility of denture sore mouth being associated with infection by the fungus *Candida* (*Monilia*) has been mentioned by a number of persons, e.g., Cahn (1936), Bartels (1937), Stones (1948), and Proctor (1955).

The clinical appearance has been well described by Nyquist (1954) although he ascribes the condition to badly made and ill-fitting dentures. He showed that two types occurred; one presenting an inflamed, œdematous and granular surface (*Fig.* 1), the other an inflamed, œdematous and glossy smooth surface (*Fig.* 2). The patients often complain of an itching or burning sensation accompanied by dryness of the mouth.

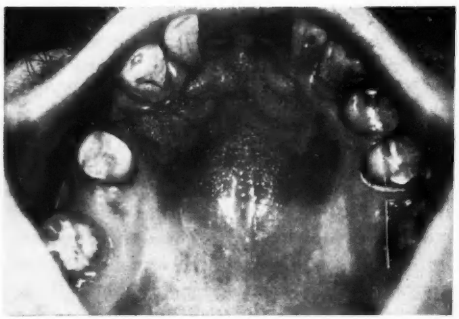

Fig. 1.—Denture sore mouth showing inflamed, œdematous, and granular surface.

Fig. 2.—Denture sore mouth showing inflamed, œdematous, and granular surface anteriorly and in midline of palate; and glossy, smooth surface.

Since none of the previous workers had given figures to substantiate their findings it was decided to investigate cases of denture sore mouth with the appearance described by Nyquist to see if *Candida* was associated with it. The palates of these cases were swabbed by routine bacteriological methods and the organisms grown on blood-agar and blood-agar-tellurite media. The results are given in *Table I*, where it can be seen that in 72 per cent of cases *Candida* was grown.

Because *Candida* may well be a normal inhabitant of the mouth and not associated with denture sore mouth, a series of control swabs was taken. These were from normal mouths with dentures; cases presenting ulcers, both aphthous and dental; and routine periodontal cases with and without dentures. The results are given in *Table II*, where it can be

seen that of all the cases 83 per cent did *not* grow *Candida*.

The treatment advocated previously by Cahn (1936) and Bartels (1937) was painting the affected area with gentian violet and immersing the dentures in a mild solution of hypochlorite each night. The disadvantages of gentian violet treatment are primarily the staining and taste, and secondly, the difficulty of self-application by the patient, while that of hypochlorite is the possibility of bleaching of the denture.

Keeney (1946) successfully used a fatty acid fungicide, sodium caprylate, for the treatment of oral and vaginal thrush and it was decided to test the efficiency of this substance in some of the cases under investigation. After a series of preliminary experiments, the following

Table I.—Showing Number of Cases of Denture Sore Mouth from which *CANDIDA* was Recovered

Patient	Appearance		Bacteriological Examination	
	Smooth	Granular	Positive	Negative
J. S.		×	×	
L. H.	×		×	
E. R.		×	×	
V. H.		×	×	
M. C.	×		×	
K. M.		×	×	
D. A.		×	×	
A. S.	×		×	
E. R.	×		×	
D. A.		×	×	
H. P.		×	×	
D. S.		×	×	
G. D.		×		×
M. C.		×	×	
G. K.		×	×	
N. A.		×	×	
E. V.		×	×	
J. F.		×	×	
M. T.		×		×
P. V.		×	×	
E. D.		×	×	
F. B.	×			×
M. D.	×			×
K. L.	×			×
K. A.		×		×
V. M.		×		×
D. G.		×	×	
V. G.		×	×	
B. B.		×	×	
C. E.		×		×
D. B.		×	×	
G. F.		×		×
E. D.	×		×	
A. W.	×		×	
H. L.	×		×	
L. S.	×			×
36 100 per cent	11 31 per cent	25 69 per cent	26 72 per cent	10 28 per cent

The organisms were isolated and identified as *Candida* by Dr. Gillespie, who found the strains to be identical in their morphology and in their ordinary cultural characteristics with the strains isolated in routine work from thrush lesions. In order to determine the species of *Candida* to which the organisms belonged, 16 randomly selected strains were examined by Miss English, the mycologist, who obtained chlamydospores on corn meal agar and found that they fermented glucose, maltose, and galactose, but not sucrose or lactose. She identified the organism in all these cases as *Candida albicans*.

We have not mentioned *Candida albicans* in the article because the remaining cases were not typed by the mycologist.

jelly was evolved incorporating 10 per cent sodium caprylate as the active principle.

This jelly is fungicidal, non-staining, and can be easily applied to the affected area by smearing it on the fitting surface of the denture. It has the disadvantage of causing a burning sensation when first applied, but this quickly passes and we only found one patient who could not tolerate it.

Table II.—Showing Number of Control Cases from which *Candida* was Recovered

Patient	Normal Mouths				Bacteriological Examination	
	Wearing Full Dentures	Wearing Partial Dentures	Perio-dontal Cases	Ulcers	Positive	Negative
E. S.	×					×
E. Sm.	×					×
E. W.	×					×
T. P.	×					×
F. D.	×					×
L. B.	×				×	
G. R.	×					×
M. E.	×					×
D. H.		×			×	
M. B.	×					×
A. G.	×					×
A. H.				×		×
N. F.				×		×
D. L.		×				×
W.			×		×	
K. M.			×			×
H. B.			×			×
B. S.				×		×
H.			×			×
B. L.			×			×
M. F.			×			×
L. H.		×			×	
P. W.		×				×
B. C.		×				×
24 100 per cent	10 42 per cent	5 21 per cent	6 25 per cent	3 12 per cent	4 17 per cent	20 83 per cent

Sodium Caprylate Jelly★

	per cent
Sodium alginate	4
Sodium caprylate	10
Glycerine	20
Carboxy methyl cellulose	1
Sorlate	1
Aqua	ad 100

Not all cases, however, responded to the caprylate jelly. The reasons for this are not clear and need further investigation.

All caprylate resistant cases responded to treatment by a non-staining fuchsonium compound closely allied to gentian violet. This compound—sodium diamino-disulphomethyl-fuchsonium-sulphonate—when combined with sodium biborate proved effective in the treatment of vaginal thrush (McKay Hart and Hatton Brown, 1951, 1952). For oral use it has been incorporated by the manufacturers in a pastille base, one pastille being prescribed three times a day. The disadvantage of the fuchsonium pastilles was the necessity for the patient to remove the denture when sucking the pastille and in any event there was not the continuous close application of the drug to the tissues obtained with the caprylate jelly. This disadvantage could be overcome by

★ Sodium Caprylate Jelly made to the formula given in this article is now available under the name of Caprygel from Ferris & Co. Ltd., Bristol 2.

incorporating it in a jelly instead of a pastille and is worthy of further investigation.

As noted above the nightly immersion of the denture in weak hypochlorite was probably contra-indicated; in this series of cases the dentures were therefore immersed in 5 per cent cetrimide. This solution is not ideal as it tends to stain the denture. This stain, however, can be removed by buffing on a lathe.

The cases investigated included patients wearing full and partial dentures, and the results of treatment are given in *Table III*.

Table III.—A Series of Denture Sore Mouth Treated with Fungicides

Patient	First Bacteriological Examination		Treatment				Final Bacteriological Examination		Clinical Result			
	Negative	Positive	Cetrimide	Sodium Caprylate	Fuchsonium Compound	Gentian Violet	Negative	Positive	Cured	Improved	Defaulted	Not improved
J. S.		×	×	×			×			×		
L. H.		×				×	×		×			
E. R.		×			×		×		×			
V. H.		×	×	×	×		×		×			
M. C.		×		×			×		×			
K. M.		×	×	×	×			×	×			
D. A.		×	×	×			×		×			
A. S.		×	×	×			×		×			
E. R.		×	×	×			×		×			
D. A.		×	×	×			×		×			
H. P.		×	×	×				×		×		
D. S.		×	×	×				×	×			
G. D.	×		×	×			×		×			
M. C.		×	×	×							×	
G. K.		×	×	×				×		×		
N. A.		×	×	×				×		×		
E. V.		×	×	×	×		×		×			
J. F.		×	×	×	×			×		×		
M. T.	×		×	×				×		×		
P. V.		×									×	
E. D.		×	×	×				×				×
F. B.	×						×		×			
M. D.	×				×		×		×			
K. L.	×						×		×			
K. A.	×										×	
V. M.	×										×	
D. G.		×	×	×	×	×					×	
V. G.		×									×	
B. B.		×									×	
C. E.	×										×	
D. B.		×									×	
G. F.	×		×	×			×			×		
E. D.		×									×	
A. N.		×									×	
H. L.		×									×	
L. S.	×										×	
36 Number of completed treatments	10	26	19	20	7	2	15	8	15	7	13	1
23	6	17	17	18	6	1	15	8	15	7		1
Per cent completed cases	26 per cent	74 per cent					65 per cent	35 per cent	65 per cent	30 per cent		4 per cent

It can be seen that of 36 patients included in this investigation, 15 were cured, 7 showed improvement, 1 showed no improvement, and 13 cases defaulted. This group of defaulters include those who actually defaulted from treatment, those whom it was not possible to follow up, and cases where a final bacteriological examination could not be made. Most of the defaulting group were either cured or improved when last seen. The one case that was not improved objected strongly to the caprylate after 48 hours, on account of its burning and had no further treatment other than immersing the denture in cetrimide. It will be noted that of the cured cases only 2 had positive swabs at completion of the treatment, whereas all the cases that were improved but not cured were positive. Four cases that clinically appeared to be typical denture sore mouths associated with *Candida*, and were treated as such, never gave a positive result for *Candida*. One other case diagnosed and treated as *Candida* infection was negative at commencement but became positive after treatment and was not completely cured. Of the patients where treatment was carried through to completion 65 per cent were cured and 30 per cent improved. Seventy-four per cent had their dentures immersed each night in cetrimide, 80 per cent had sodium caprylate jelly, and 23 per cent were treated with the fuchsonium compound either by itself or in combination with the caprylate.

This preliminary investigation reveals therefore that 72 per cent of denture sore mouths were associated with *Candida* infections, that 83 per cent controls were not associated with *Candida*, 95 per cent cases were cured or improved by treatment with sodium caprylate and a fuchsonium compound either together or singly, and nightly immersions of the dentures in 5 per cent cetrimide.

As a result of the antifungal treatment œdema subsided and the dentures became increasingly loose and in 80 per cent of cases new dentures were provided. Impressions were not taken until it was reasonably certain that most of the swelling had resolved. Any mechanical factors that may have been a predisposing cause to the *Candida* were corrected.

ANGULAR CHEILITIS

Quite early in the investigation the number of cases presenting with angular cheilitis was noticed. Thirty-three per cent of cases had

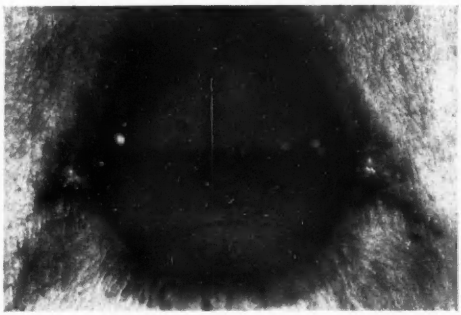

Fig. 3.—Angular cheilitis associated with *Candida* infection.

this complaint. This is a much higher incidence than is normal amongst denture wearers and we concluded that it must be looked upon as another manifestation of denture sore mouth associated with *Candida* infection. *Fig.* 3 shows a case from which *Candida* was isolated. Waisman (1955) drew attention to the number of cases of thrush showing angular cheilitis and says it is regrettable that it should be considered a symbol of avitaminosis. All the cases that exhibited angular cheilitis in our series cleared up when the denture sore mouth was successfully treated. Some were given a simple analgesic ointment, others had no treatment whatever, but all were either healed or healing before new dentures were made.

DISCUSSION

This preliminary investigation of a small series showed that *Candida* could be cultured far more frequently from denture sore mouths (72 per cent) than from normal mouths (17 per cent). It was therefore presumed that the organism was in some measure responsible for the condition or had become superimposed upon it.

Treatment of cases with fungicide brought about cure or improvement in all but one case. This indicated that *Candida* infection could, in fact, be viewed as partly, if not wholly, responsible.

It is of interest to note that all cases showed improvement and some were completely cured while wearing their original dentures and this demonstrated that the dentures themselves were not directly responsible either by the nature of their construction, their fit, or the material of which they were made. The traumatic effect of ill-fitting or badly constructed dentures on the tissue may well be a predisposing cause, however, and it is felt that if faults are noticed in the dentures new ones should always be provided.

In addition it seems highly probable that the denture may be a source of reinfection. In several cases a more profuse growth of *Candida* was obtained from the denture than from the mouth, and in 2 cases positive cultures were obtained from the denture when the mouth was negative. It seems reasonable to suppose that a denture base showing a rough-fitting surface or porosity can harbour organisms in situations difficult to reach with cetrimide. Such foci could be responsible for relapses after cessation of treatment.

This view of an acrylic base as a harbouring agent for *Candida* may well explain the frequent cure of similar cases treated by the substitution of a stainless-steel base. Metal bases of this nature are obviously more hygienic than acrylic bases and the cure of what was often diagnosed as acrylic sensitivity may not have been brought about by change of material but by the eradication of reinfecting organisms.

Another interesting aspect is the frequent association of angular cheilitis with denture sore mouth and the fact that all cases in this series resolved without treatment other than that given to the intra-oral condition. Here again as with the cases of denture sore mouth, the dentures may have provided the predisposing cause, but it is evident that neither decreased vertical dimension nor faulty construction could have been solely responsible, and that avitaminosis—if a contributory factor—could have had a predisposing effect only.

Acknowledgements.—The authors are very grateful to Dr. W. A. Gillespie, M.A., M.D., M.R.C.P.I., D.P.H., for carrying out the bacteriological part of this work, to Miss M. P. English, M.Sc., for her mycological assistance, and to Mr. G. H. Darling, F.P.S., for his pharmaceutical assistance. The authors are also indebted to Mr. F. G. Godman of the Department of Clinical Photography, University of Bristol, for the photographs and to the Camden Chemical Co., for their generous supply of the fuchsonium compound pastilles which are now generally available as Pruvoral Pastilles.

Addendum.—Since this article was prepared for publication, the authors have been using Pruvagol Cream supplied by the same company. This is smeared on the denture in the same way as the sodium caprylate jelly, but it is as yet too early to assess results.

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DENTAL RADIOGRAPHY

A two-day course in dental radiography has been arranged for dental nurses and assistants, to take place on Thursday and Friday, May 23–24, 1957, at the Ilford Limited Department of Radiography and Medical Photography, Tavistock House North, Tavistock Square, London, W.C.1.

No fee is charged for this course. Application forms will be sent on request.

EARLY RECOGNITION OF SOME AETIOLOGICAL FACTORS IN TEMPOROMANDIBULAR JOINT DISORDERS*

By H. E. WILSON, L.D.S. (Q.U.B.), D.Orth. (Eng.), D.D.O. (Glas.)

My interest in disorders of the mandibular joint was for some time casual, but heightened after a number of these cases had been referred for orthodontic opinion and treatment. As a result, I became more aware of the association between malocclusion and the disordered joint. It pleased me when my early cases were successful, the correction of the malocclusion resulting in a marked improvement in the joint symptoms. The majority of these cases were easily diagnosed and easily treated, most of them being cross-bites.

As time passed, more puzzling cases came my way, also fewer startling successes. Nevertheless, most cases improved following orthodontic treatment and, as Dr. Campbell (1954) pointed out, I have "learnt even more from the occlusal breakdown of patients who have never known orthodontic care" and I "get along perfectly well with a good pair of eyes and palpating finger-tips". The only other aids are joint X rays and an anatomical articulator.

It is assumed that when the condyle is displaced distally the symptoms arise as a result of the pressure on the posterior fibrous part of the disk, termed by Rees (1954) the bilaminar part, and said to be well supplied with blood-vessels and nerves (Sicher, 1948; Hankey, 1954). I have no intention of reviewing the literature on the subject and its many aspects; it is so voluminous and little of it deals with the orthodontic approach (Schreiber, 1954).

It became obvious early that the direction of mandibular displacement was significant if orthodontic treatment was to be planned and successfully executed. With this in mind I classified the cases as: (1) Over-opening; (2) Over-closure; (3) Lateral displacement; (4) Backward displacement (Wilson 1952, 1953).

To each may be added the subdivision of "unilateral" or "bilateral", and in my opinion these will include all the mandibular displacements associated with joint disorders. It is based on Thompson's (1946) concept of the resting position of the mandible and the freeway space and his belief that the condyle rotates in normal cases when the mandible moves from the resting to the closed position. All displacements refer to the movement of the mandible from the resting position.

1. Over-opening.—Cases of over-opening are rarely referred to the orthodontic clinic. The symptoms are seldom severe and consist chiefly of a clicking either during the opening or closing movement. The patient often does it voluntarily. Reasons put forward for the cause of the clicking are numerous, but none has definitely been established. Indeed there may be almost as many reasons as there are "clicks". It occurs initially with yawning, singing, following extraction, or, as in one case, by biting hard on an object on the molar teeth, or with anything which displaces the condyle forward over the emenentia, this being referred to as subluxation. Treatment is limitation of movement and, since it so often is repeated voluntarily, demands the co-operation of the patient. When the symptoms are more severe, intermaxillary wiring may be used.

I have noticed that some cases of over-opening are associated with a pre-normal occlusion or an obtuse-angled mandible. It would appear that when the mandible is opened the average distance between the incisors in Class III types is less than the normal incisal relationship, so the individual opens a little more to produce an opening wide enough for the introduction of food; in so doing the condyles are moved over the emenentia. In the obtuse-angled mandible it appears to be a feature associated with the skeletal type.

* Paper read at the meeting of the British Society for the Study of Orthodontics held at Newcastle upon Tyne on Friday, May 11, 1956.

There may be unilateral subluxation of the condylar head; if this is so, it is generally confined to the same side each time, but there may be a bilateral subluxation, in which case one side slips forward followed by the other, the chin point moving to one side then the other. Simultaneous subluxation of the two joints is less common in my experience.

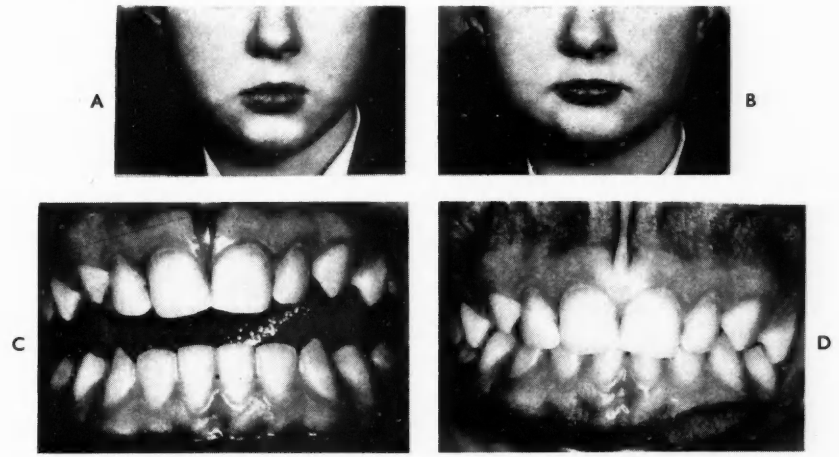
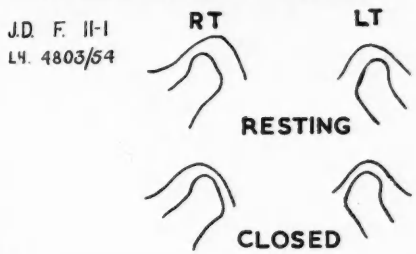


Fig. 1.—Showing resting (A, C) and closed (B, D) positions. There is overclosure and distal displacement of condyles.

Severe pain rarely appears unless associated with some other form of displacement, for example, in the mutilated case with lateral displacement or gross over-closure.

In children over-opening can easily be missed. The child patient is rarely asked to open as widely as possible with the intention of observing the condylar movement. It may be recognized when taking impressions or fitting appliances provided one is alert to the movements of the mandible. When recognized, correction is not difficult. It is easy to convince the patient that it is to his or her advantage to resist clicking the jaws, which is often the only symptom. I have found that after six to nine months the young patient is unable to over-open voluntarily as before, provided the skeletal pattern is favourable. In the obtuse-angled mandible with short ramus, over-opening may be almost impossible to control and some of these types appear to have a small condyle in a small, comparatively deep, fossa.



2. Over-closure.—In over-closure of the mandible the condyle is thrust back against the fibrous posterior part of the disk. The clinical picture is often poorly-designed dentures or grossly-mutilated dental arches. Accordingly, the over-closure, and consequently the symptoms, may be unilateral or bilateral. Treatment is bite rehabilitation by prosthetic appliances, or bite-opening appliances to reconstitute the vertical height and prevent the distal displacement of the condyles. Prognosis is generally good, the symptoms being alleviated within a day or two.

Over-closure occurs in cases of large freeway space (*Fig.* 1), and in these the excessive movement may be prevented by bite-raising appliances or onlays. Early recognition of this type is not difficult. In my opinion there are two reasons for large freeway space: (*a*) lack of alveolar growth associated with a general condition, or with a local factor such as partial or complete anodontia, which cannot be corrected; (*b*) behaviour and size of tongue; if the tongue normally rests between the upper and lower teeth it will prevent their full eruption. It is known that there can be an association between an anterior tongue thrust and an anterior open-bite and that when the tongue thrust is corrected the teeth come together. It is possible for a similar association to exist between the cheek teeth and the tongue. There is no method of determining whether or not a tongue is large in relation to the dental arches and jaws. At times, when it rests between the upper and lower teeth, it appears large, while at other times its size seems normal and its position due to tongue behaviour. In the former type the prognosis is not good; in the latter it is better but doubtful. Correction of the freeway space will correct the mandibular and condylar displacement.

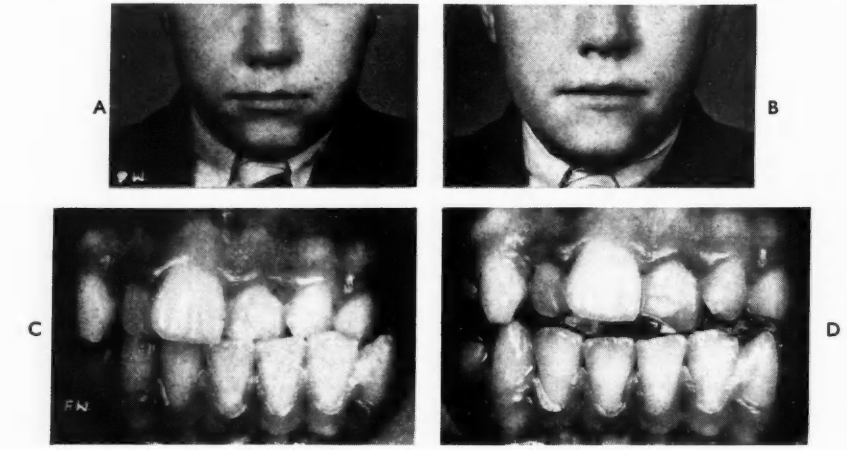


Fig. 2.—Shows the centric occlusal (B, D) and occlusal (A, C) positions with cross-bite and mandibular displacement to the left which result in a distal displacement of the left condyle, as shown in X-ray tracing.

Diagnosis of the resting position and large freeway space is not difficult when the patient has upper and lower anterior teeth. My method is to sit in front of the patient who is asked to sit upright in the dental chair and we carry on a conversation. I notice the position to which the lower teeth return during speech and this gives the resting position; then the occlusal position is noted and from these the freeway space is measured. Other diagnostic aids are speech, which may give the first clue, and the impression of the teeth on the tongue. Speech may be "thick", which I tend to associate with the large tongue and the lateral sigmatism which suggests tongue behaviour.

Treatment for the tongue behaviour consists of exercises by a speech therapist and a form of internal oral screen, for example, a monobloc. Where there has been some lateral collapse or narrowing of the arches in the premolar region associated with tongue behaviour, the arch may be expanded and in the improved environment the tongue behaviour improves.

clinically, caused by the position of one or two teeth; treatment depends on the individual and may be orthodontic (with an expansion plate) or occlusal grinding.

These conditions are easily recognized early and their treatment is generally simple and straightforward. In the deciduous dentition, grinding of the offending cusp may be all that

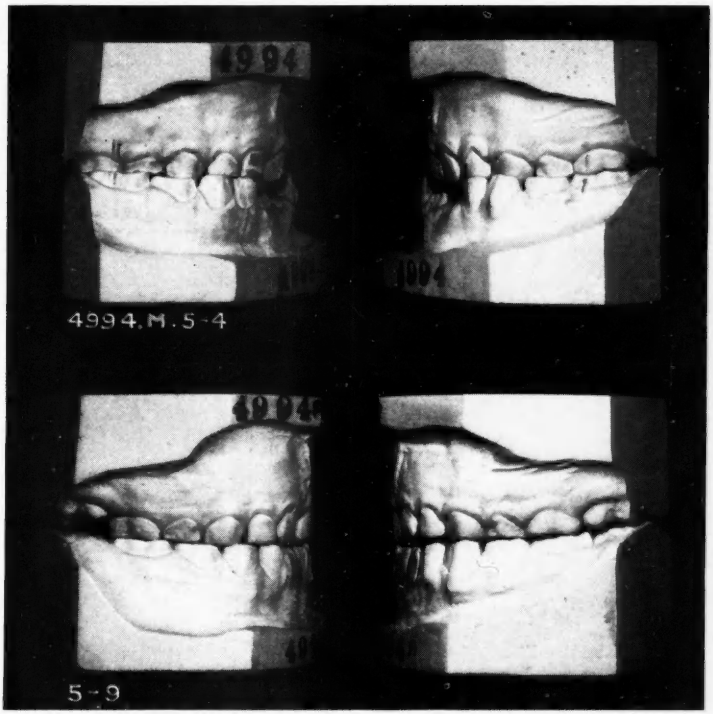


Fig. 3.—Shows cross-bite, with lateral displacement corrected by grinding, only in five months.

3. Lateral Displacement.—This displacement is probably the most easily diagnosed. The symptoms are usually unilateral and on the side to which the mandible moves. One condyle is moved distally against the posterior part of the disk while the other is stationary or moves forward (*Fig.* 2). In established cases expansion may be attempted, or grinding to allow centric occlusion. The prognosis is good and orthodontic treatment usually produces a stable occlusion. There may be mild cases of lateral displacement, difficult to observe is required, or, at the most, simple expansion. Grinding of permanent teeth is not indicated at this age (*Fig.* 3). Cross-bite due to a narrow upper arch resulting from a sucking habit must be treated initially by correction of the habit.

4. Backward Displacement.—This displacement is probably the most difficult to diagnose as it is almost impossible to observe clinically. It is often associated with Class II, Division 2 type of occlusion. The mandible is thrust backwards carrying the condyle against the posterior part of the disk, producing severe

symptoms which are usually bilateral but may be unilateral (*Fig.* 4). The most useful guide to diagnosis is the attrition of the teeth, which, if carefully noted, will assist in building the picture of the functional occlusion. Attrition on the incisors is not difficult to observe (Weinberg. 1956), but on other teeth it can

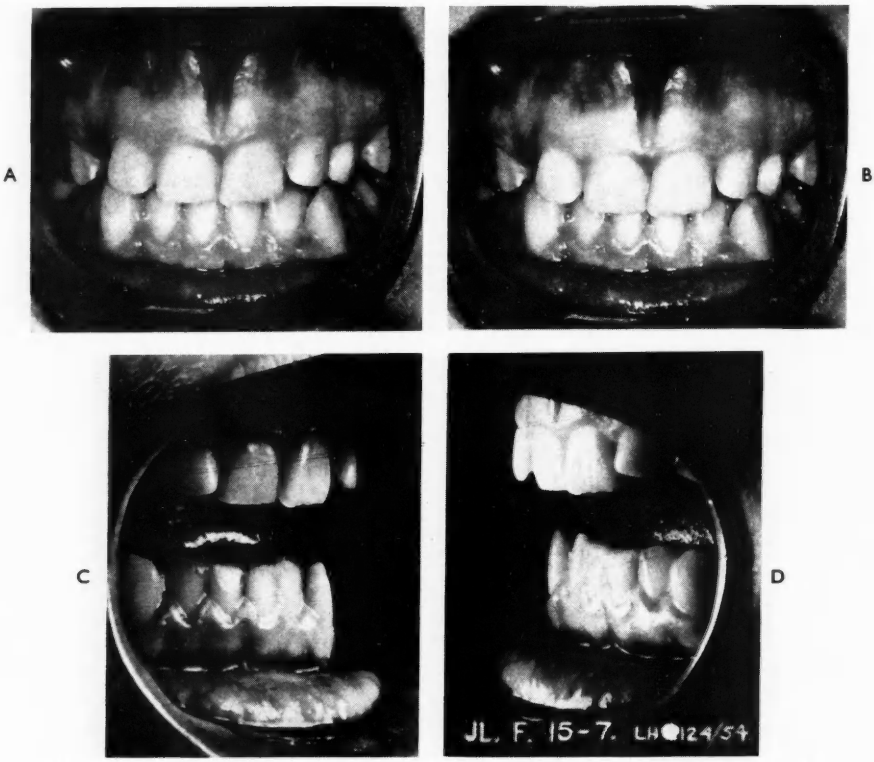


Fig. 4.—Showing teeth in initial contact (A) and in occlusion (B). The movement from one position to the other was sharp and quick. C, D show attrition on labial aspect of $\overline{1|1}$. Radiographs confirmed distal displacement of the condyles following the backward displacement of the mandible.

be easily overlooked. Canines are often involved when they tilt distally and lingually, occluding in such a way as to produce the backward thrust. Occasionally, a tilted molar or molars may be responsible. Radiographs of the joints taken in the resting and closed positions are of some assistance.

Treatment may be by bite-raising appliance or grinding of the offending cusps. Orthodontic treatment usually consists of correction of deep overbite and arch relationship. In some mutilated cases it is necessary to correct the incisal relationship with orthodontic appliances to retain the corrected arch and support the occlusion.

Early recognition of distal displacement is confined chiefly to deep overbite cases. Removable appliances with inclined planes are remarkably successful with, or without, extraction of upper premolars. If this treatment fails, which it rarely does, the case is re-assessed.

Schwartz (1956) has shown that it is possible for people with normal occlusion to retrude the mandible and so compress the disk voluntarily.

The interesting question arises why some cases with a traumatic bite will produce a

parodontal condition while others produce joint symptoms. A deciding factor may be the direction of force applied to the tooth; if it is in a vertical direction and along the long axis of the tooth, it will displace the mandible, but if the force is applied horizontally it will

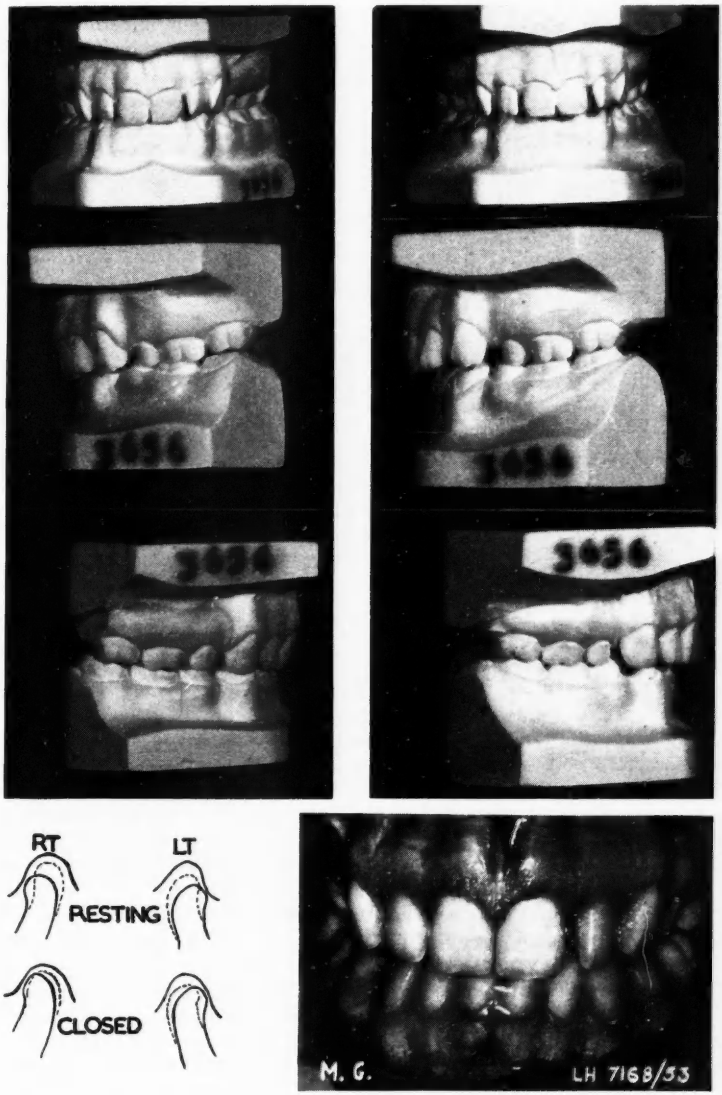


Fig. 5.—Extraction of four first premolars for orthodontic treatment resulted in deep overbite and backward mandibular displacement with joint symptoms. Treated with a removable appliance. Models show progress of treatment with change in arch relationship and correction of deep overbite. Joint tracings show the position of the condyles in the resting and closed positions before (broken line) and after (continuous line) treatment. Intra-oral photograph shows the result one year later.

tend to loosen the tooth. The support of the proximal teeth may be sufficient to resist the breakdown of the parodontal tissues which might otherwise occur if the tooth is isolated. In the case of canines, the morphology and size of the tooth may determine the result and in addition it comes under the influence of the strong muscular modiolus of the cheek which may prevent its labial displacement. Where there is a premature and sliding contact involving this tooth the result is a mandibular displacement. Rarely does it produce pathology of the parodontal tissues.

Having learned something of occlusal breakdown in adults and become familiar with the type of occlusion which is commonly associated with joint disorders, one automatically applies the knowledge gained to the orthodontic patient and endeavours to correct those malocclusions likely to produce joint symptoms later, and what is probably more important, to avoid producing such occlusion with orthodontic treatment. It occasionally happens that in correcting a cross-bite a lateral displacement is produced. For example, a unilateral cross-bite, without mandibular displacement, corrected by symmetrical expansion of the upper arch may produce a lateral displacement of the mandible. Extraction of upper first premolars in some Class II cases and four first premolars in Class I cases, and retraction of the incisors, can produce a deep overbite and a distal tilting of the canines which will result in a backward displacement (*Fig.* 5). This may be an argument in favour of extracting lower second premolars rather than lower first premolars in cases of bimaxillary crowding because it produces less anterior collapse. Backward displacement can also be produced by late extraction of lower first molars, allowing the second molars to tilt excessively, and in Class III occlusions where the lower incisors are retroclined and the upper incisors proclined.

The orthodontist may consider being satisfied with producing an edge-to-edge bite where

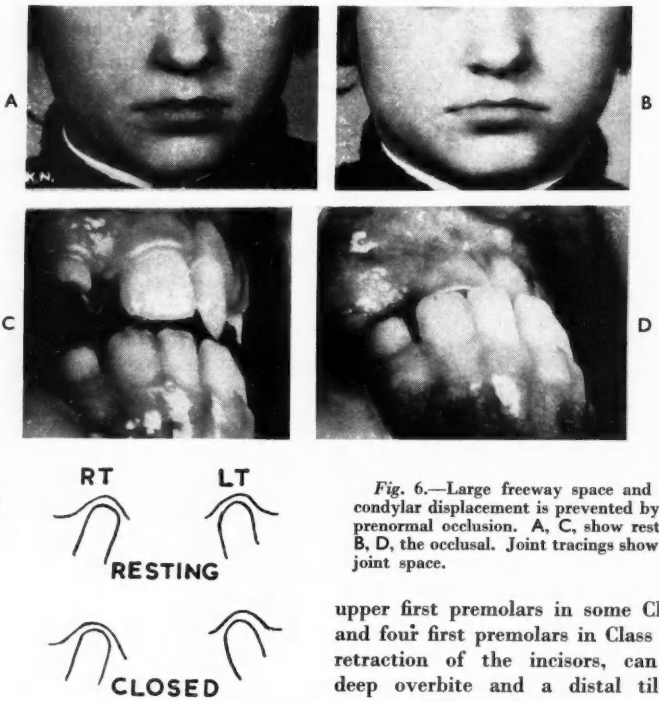


Fig. 6.—Large freeway space and over-closure; condylar displacement is prevented by the postural prenormal occlusion. A, C, show resting position; B, D, the occlusal. Joint tracings show no change in joint space.

possible, rather than an overbite, in some prenormal cases. It is an excellent procedure to see treated permanent dentition cases six months after appliances have been removed and to do selective grinding where there is premature contact or slight mandibular displacement.

No mention is made of the forward mandibular displacement or the postural Class III. In my experience such an occlusion does not produce trauma within the joint unless it is associated with some other form of mandibular displacement. Even so, the forward bite can cancel out the distal displacement produced by an over-closure, as in the case illustrated (*Fig.* 6). I may be wrong and, as suggested by Dr. Campbell (1954), there is a nipping of the disk between the condyle and the emenentia in some of these cases.

It is not suggested that all mandibular displacements eventually produce joint conditions. We can only do what we consider best for the patient and, if a mandibular displacement is unavoidable, hope that the other factors do not appear to produce the joint symptoms.

What are these other factors? Schwartz (1955) lists them as:—

1. Predisposing: consisting of constitutional (physiological) temperamental (psychological).
2. Contributing: occlusal abnormalities.
3. Precipitating: sudden or continuous stretch (yawn, wide bite, long dental operation); sudden or extensive changes in proprioception (occlusal alteration through restoration or selective grinding).
4. Aggravating: alarming diagnoses or physiological or psychological traumatic treatment.

The separation of the known factors in this manner has some merit, but I do not completely agree with it. The important or primary factor is the mandibular displacement which may be predisposing at one time and contributing at another. There are many cases where there was no precipitating factor, such as a sudden blow, and the symptoms have a more gradual onset.

It must be accepted that temperament and the psychological state are factors (Moulton, 1955). The much higher percentage of females presenting with the symptoms confirms the temperament. Symptoms appear during periods of "stress" which produce the psychological state, which in turn produces the muscular tension. Thus the teeth are held in occlusion, and the joint, instead of receiving a mild repetitive traumatic force which it can withstand, may receive an almost continuous one. Lewis (1942) has shown that pain in muscle may resemble pain from the joint, and this may account for some of the pain symptoms. In those cases where there is no marked mandibular displacement, muscle tension may partly be the answer. Cases have been successfully treated by instructing the patient to relax. The change can be surprisingly rapid, the symptoms disappearing in a few days. One case of a young man with joint symptoms will illustrate the point: he had a fair complement of teeth with good functional occlusion, except on the right lower molar region where several teeth had been lost. His father had recently died from cancer and he had the responsibility of running the small family greengrocery business and was under considerable mental stress. When assured that he had not a similar condition to his father he was greatly relieved and received instruction in relaxation. He was not seen again, but some weeks later he wrote saying he had no further symptoms and considered it a waste of time to visit the hospital again. There are people with less obvious worries who also benefit from this advice.

A cycle of factors goes to produce the joint symptoms; they include mandibular displacement, temperament, psychological state, muscle tension, trauma, and the morphology of the joint. If the cycle is broken there is relief. The most effective measure appears to be decompression of the disk where there is distal displacement of the condyle, or rest when there is over-opening.

Description of the normal mandibular and condylar movements and structure is best left to the research workers on the subject (Posselt, 1945).

I have not discussed the variety of symptoms associated with joint conditions because those

who have worked in this field have not been able to produce anything significant, nor have I discussed causes other than intrinsic or extrinsic trauma. It is obvious that these must be eliminated. Hankey (1954), in his survey of 150 cases, found 6 due to other systemic and pathological conditions, which is only 4 per cent of all cases. Almost all joint disorders, therefore, are associated with some form of mandibular displacement or trauma. Keeping this in mind, I am never satisfied with a casual examination of the functional behaviour of the oral cavity when there are joint symptoms present. What at first sight may appear to be a good occlusion may, in fact, produce a slight mandibular displacement which is sufficient to account for the symptoms. In such mild cases, joint radiographs may not be of much assistance, since the reduction in joint space may be small and within the normal range, so not easily diagnosed from radiographs. The anatomical articulator may help in studying the premature contact, but there is no easy road to diagnosis and these two techniques only supplement the clinical examination.

In conclusion, orthodontic treatment for temporomandibular joint cases can be of considerable benefit to the patient by removing the cause of the mandibular and condylar displacement. In treating these cases considerable knowledge is obtained of the type of conditions where occlusal breakdown occurs. This knowledge can be employed in treating orthodontic cases to correct or avoid the occlusal states likely to produce joint disorders later.

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The Epithelial Attachment (The Attached Epithelial Cuff)

The findings of Gottlieb and Waerhaug are discussed and a report of the investigations presented.

Six dogs and four adult monkeys were used in three types of experiments. In one, a steel blade was inserted into the gingival crevice, in the second, a flap was reflected and repositioned, and a mylar strip was inserted into the gingival crevice in the third experiment.

In young dogs it was impossible to detach the gingivæ from the enamel without causing tears in the epithelium or in the connective tissue. It was also impossible to insert a thin strip of either steel, mylar, or celluloid between the epithelium and the enamel, as such a strip caused tears in the epithelium or penetrated through into the connective tissue.

The authors do not believe that epithelium is made adherent to the tooth surface by formalin fixation, but rather that the gingival epithelium is, in the true sense of the word, attached to the enamel surface, and for this reason, the term attached epithelial cuff is suggested.—ORBAN, B. J., BHATIA, H., KOLLAR, J. A., WENZ, F. M. (1956), *J. Periodont.*, **27**, 167.

Treatment of the Vital Exposed Primary and Young Permanent Teeth

Because of the cellular activity of the primary molar pulp tissue, the calcium hydroxide technique for the treatment of exposures in these teeth is unreliable. Instead, a technique is described in which antiseptics and mummifying agents are placed on the vital root canal contents, and the tooth subsequently restored in the usual way.

In young permanent teeth success with calcium hydroxide is much higher, and so this material is preferred.—SWEET, CHARLES A., jun. (1956), *J. Dent. Child.*, **23**, 86.

SERIAL ARTHRO-RADIOGRAPHY FOR THE EXAMINATION OF THE TEMPOROMANDIBULAR JOINT*

By **SYDNEY BLACKMAN**, L.R.C.P., M.R.C.S., D.M.R.E.

Director, X-Ray Department, The Royal Dental Hospital of London

THE study of the temporomandibular joint, its anatomical structure and its movements, in health and disease, has grown in importance and intensity during the last two decades. The role of radiography in this area is invaluable, providing as it does the means of acquiring an intimate knowledge of the structure of the joint together with a sound concept of its functional activity.

Injuries and diseases of the temporomandibular joint have become the combined interest of the medical and dental professions, with plastic surgery playing an ever-increasing part. Temporomandibular arthrosis is to-day a well-recognized field for investigation and specialized treatment, and has a pathogenesis covering dental anomalies and diseases, inherent joint disturbances, and extrinsic factors of musculature, ligamentous, and neurogenic origin.

Many of the signs and symptoms are common to a number of conditions, and clinical examination alone cannot determine the underlying lesion associated with stiffness of the joint, restricted movements or hypermobility, pain on mastication, or tenderness on palpation. With improved X-ray techniques many of these problems are being successfully investigated.

The common drawbacks of superimposition and distortion are much in evidence in facial and extra-oral radiography, and an X-ray portrayal of the temporomandibular joint has, in the past, submitted information which has been often doubtful and inconclusive. With the short anode-film-in-distance technique, using slow-speed high-definition intensifying screens, it is now possible to produce clear and well-defined images of the joint and its immediate surrounding structures.

It must be remembered that the radiologist is limited to the demonstrations of the osseous components of the joint; yet affections of the non-osseous and non-demonstrable tissues are frequently the cause of the patient's symptoms. However, if the contours of the condylar head of the mandible, the glenoid fossa of the temporal bone, and the eminentia articularis are sharply revealed on the film, the condylar-fossa relationship can be studied in all the excursions of the mandible.

No appraisal of the condition of the temporomandibular joints of a patient can be regarded as complete unless they are viewed from positions of closure, at rest and on full opening, and then in careful comparison of one side with the other. With this in mind, Professor William Updegrave, of Temple University, Philadelphia, has devised a special slide-tunnel angle board, in which a cassette can be inserted and propelled, similar to serial investigation of the duodenal cap or stereoscopic examination of a particular region. This permits multiple exposures of the joint without changing the position of the patient. By turning the face around and reversing the cassette, three identical views are taken on one film of both joints in the three positions of closure, rest, and full opening, and full scrutiny and comparison made simultaneously.

This advance in the radiography of the temporomandibular joint is improved further by fixing alinement rods to the tunnel-board in an attempt to stabilize the X-ray tube in its relationship to the film in the cassette. This effort at standardization is not fully successful, as the personal factor of visual adjustment with these alinement rods allows the introduction of an error, however small,

* Presented at the Meeting of the Worcester Odontological Society, held on Wednesday, November 14, 1956.

and this criticism also applies to the positioning of the head on the angle board. The head is rotated from the sagittal plane "to assume a comfortable position with the side of the jaw lying flat on the board": the duplication of the patient's head position at subsequent examinations is not fully ensured, even though a protractor is employed in the latest modification of his apparatus.

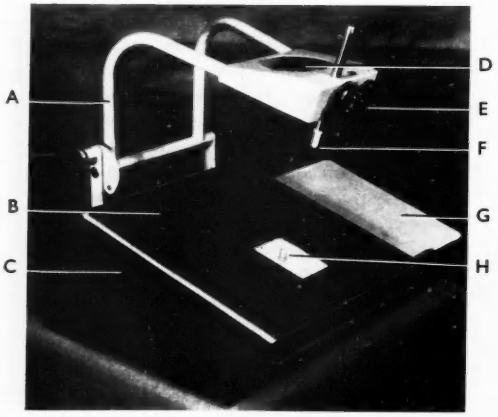

Fig. 1.—A, Head bracket carrying metal box; B, Plastic slab covered with lead-rubber; C, Slide tunnel; D, Aperture for tube head; E, Adjustable screw for plastic ear positioner; F, Plastic ear positioner (movable); G, Loaded cassette; H, Plastic ear positioner in aperture in lead-rubber covering.

The demand by the orthodontists for a "fool-proof" apparatus which can be used for radiographic study of the functional movements of the temporomandibular joint, from infancy to adult life, has stimulated me to extend the Updegrave technique towards a higher degree of precision which would cope with repetitive examinations and mass investigations.

There will always be a difference of opinion as to whether the joint should be radiographed with the head in the upright position or resting on an angle board. The protagonists of the former claim that by tilting the head sideways to rest on a flat surface there is a tendency to produce, by pressure, a displacement of the mandible towards the opposite side. This, they aver, gives a false portrayal of the joint in the rest and open positions.

Better arguments in favour of the upright position of the head, surely, are that it allows a freer and more natural play for the muscular balance and gravity control of the joint. Again, the upright position is more comfortable and better tolerated by the patient who may be suffering from a painful injury to the face.

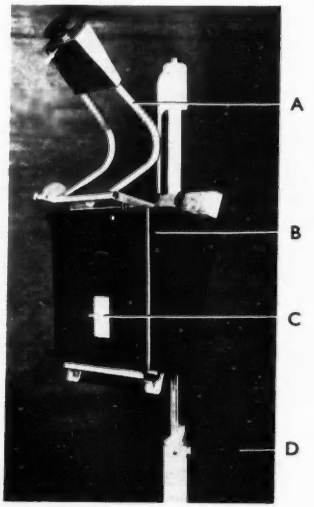

Fig. 2.—A, Head bracket carried on the upper horizontal frame; B, Slide tunnel between the board and plastic slab; C, Ear positioner to be inserted into the meatus on same side as joint to be examined; D, Ratchet controlling the raising and lowering of the board. The slide board is fixed on to an upright stand.

Favouring the upright position, a narrower, non-angled slide-tunnel board is recommended, large enough to receive a cassette containing a whole-plate, 8½ by 6½ in. cassette (*Fig.* 1). The inner facial wall of the board is lead-covered, with a rectangular aperture of 3 by 2 in. wide at its lower end in the midline, to receive the beam from the X-ray tube on to that part of the cassette and film lying immediately behind the opening.

The board may be erected by means of a support (*Fig.* 2) on to the arm of a dental chair, fixed to an upright stand, or suspended by an overhanging projection from a wall. In all three methods provision should be made for the board to be moved up and down in the

vertical axis to enable the shoulder of the patient to be placed comfortably under the lowest part of the cassette tunnel. This can be facilitated by seating the patient upon an adjustable stool, where the tunnel is wall-mounted.

The construction is of a light weight and can, if the operator so desires, be placed upon the flat surface of a table. The shoulder is always a little more difficult to manipulate when the head is tilted, to rest upon a horizontal board, and so, to obviate this difficulty, a 15° wedge could be placed under the cassette to achieve an angle-board arrangement.

The loaded cassette is introduced into the slide-tunnel with its inner edge coinciding with the inner edge of the board. The first exposure is made in this position with the temporomandibular joint closed and, when completed, the cassette is pushed along for 2 in. in the tunnel. The patient is now instructed to open the mouth so that the joint is at rest, without any effort, and relaxing the facial muscles, and the second exposure is made. For the third exposure the cassette is pushed along the tunnel a further 2 in., when its outer edge will coincide with the outer edge of the board, and the patient is enjoined to open the mouth fully in order to extend the joint. Each movement of the cassette is checked and the cassette retained in its new position by an adjustable stop on the lower margin of the board.

The accepted technique for the X-ray examination of the temporomandibular joint is in the upright position with the head parallel to the film. Centring upon a point 2 in. above the external auditory meatus remote from the film, the central ray emerging from the tube head is directed downwards towards the opposite joint against the film, at an angle of 25° using the long-distance technique, and at an angle of 15° in the short-distance procedure.

Updegrave does not maintain the head in the true lateral position, but allows the head to assume its own position with the side of the face lying flat on the cassette and the tip of the nose about 2 in. off the flat surface. The head is then supported at three points, the external auditory meatus, the zygoma, and the angle of the jaw.

This method establishes the angle of incidence for the central beam of X-rays to traverse the head, passing through little of the intervening bone structure. As far back as 1922 a device called an "X-ray directional bar" was patented for this purpose, and many modifications have been introduced in Sweden and in the United States. This consists essentially of a bar attached to the tube cone and extending forwards over the head to the external auditory meatus of the side to be radiographed. The centring of the tube cone is placed in the sigmoid notch of the other mandible.

The many anatomical variations of individuals with high and low zygomas, convex and flat, argue against a variable and non-standard position. Also, by rotating the head from the sagittal plane, the radiolucent synovial cavity is somewhat distorted and is not a true representation of the balanced gap around the head of the condyle.

The inclination of the X-ray tube and the direction of the central ray at a constant angle of 15° in the short-distance technique is an important factor in standardized examination, and for this purpose an attachment is made to the tunnel-board. Two long tubular metal arms are fixed on the upper horizontal framework of the board, about 4 in. apart, and extend upwards and outwards at an angle of 15° and bent downwards at a further angle of 90° for another 6 in., so as to contain an adult head with an average width of about 7 in.

The terminal 4 in. of the two bent tubular arms embrace a metal box in its axis and two circular apertures are cut in it, back and front, sufficient in diameter to receive and maintain the shortened cap of the X-ray tube head. In this manner the tube head is fixed at a true and constant angle of 15° with the central ray directed at the film at this angle. The metal arms carrying the box are hinged near their attachment to the board, to move up and away to accommodate the patient's head.

The fact that the head is now enclosed between the slide-tunnel board on one side and

the metal box on the outer side, provides us with the opportunity of stabilizing it as if it were in a head-holder or craniostat. Two holes are drilled in the facial wall of the board, ½ in. to the right and left of the centre and 3 in. from the lower border. These holes are

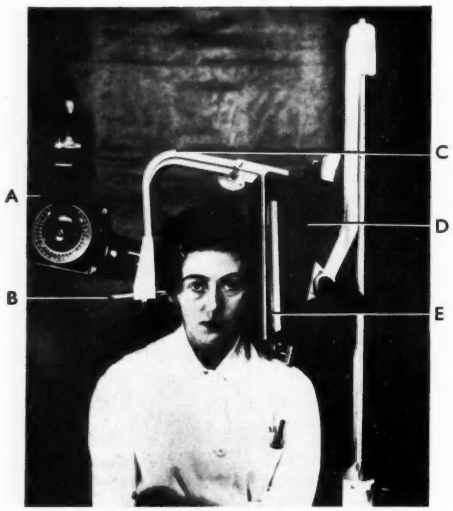

Fig. 3.—A, Tube head inserted into aperture of metal box. Incidence angle of 15°. Centred 2 in. above external auditory meatus on near side; B, Ear positioner in both meatii with head in sagittal and Frankfort planes; C, Head bracket angulated at 15°; D, Slide board in vertical plane; E, Loaded cassette in slide tunnel.

tapped to act as receptacles for plastic ear positioners, ¼ in. in diameter and ¾ in. long, which are threaded to fit in the holes. The plastic pegs are moved when changing the sides of the face, the left is introduced into the left meatus and the right peg into the right meatus.

To immobilize the head the meatus behind the joint to be radiographed receives the plastic peg positioner screwed in the tunnel-board, whilst the other peg, carried on a long adjustable arm inserted in the lower part of the metal box, is introduced into the remote meatus. The position of the head is therefore fixed and duplication of position subsequently is a simple procedure. The technique then resolves itself as follows (*Fig.* 3):—

a. The slide-tunnel board is erected in a vertical position, with the overhanging bracket hinged upwards and backwards.

b. The patient is then seated on an adjustable stool at right angles to the board, with its lower border resting on the upper part of the shoulder of the side to be radiographed.

c. The face of the patient is placed against the board, and the positioner peg introduced into the meatus with the head in the sagittal plane parallel to the board.

d. The bracket is brought down over the head and the metal box should lie near to the outer side of the face.

e. Rotate the head into the true lateral position and introduce the second peg into the free meatus. Tighten the peg and adjust the head to the horizontal Frankfort plane.

f. Bring the tube head up to the metal box and insert the shortened cap into the circular aperture.

g. The loaded cassette is placed gently into the slide tunnel, appropriately lettered and adjusted to the first position. The first exposure is made with the mouth closed.

h. After moving the cassette to the second and third positions, the respective exposures are made with the mouth at rest and open; in the latter position a mouth prop or cork is held between the teeth.

i. When the first temporomandibular joint has been radiographed in the three positions, turn the patient around, shift the peg to the second hole, immobilize the head again, remove the cassette, reverse it, reletter it, and re-insert it into the tunnel.

j. Take three exposures of the second joint.

k. The finished radiograph should be cut horizontally after complete processing and the top half reversed for comparative interpretation.

By using the short-distance technique superimposition of intervening structures is eliminated to a large degree and a film of better quality with clearer definition is obtainable. Also, the exposure time is reduced and it is possible to use slow-speed, high-definition intensifying screens with standard films.

Consistently good results are produced with an exposure time of 3½ sec., a current of 10 mA., and a voltage of 55 kV., for the average adult. For the young child the kilovoltage should be reduced.

The question of radiation danger to the patient has been given much consideration in view of the six exposures, and a 1-mm. aluminium filter is incorporated by fusion into the outer surface of the shortened cap. In addition, it is recommended that a brass diaphram of $\frac{3}{16}$ in. be inserted on the inner side of the cap (*Fig.* 4), with an aperture of about 1 in. diameter for the emergence of the X-ray beam (*Fig.* 5). The filter protects the patient and the diaphragm limits the spread of the radiation, and thus the greatest possible protection is given to the patient with the least interference to the resultant image.

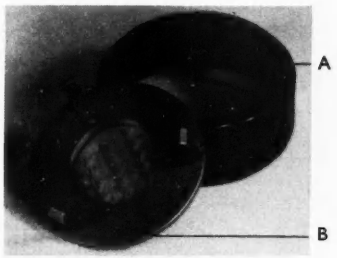

Fig. 4.—A, Shortened cone; B, Brass diaphragm.

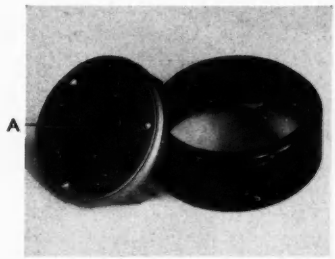

Fig. 5.—A, Filter of 1 mm. aluminium.

Under such conditions the skin-surface dosage is limited to about 10 r on each side of the head for the six exposures. Between the two alternative positioning pin locations on the facial wall of the tunnel-board, on its under side, two vertical and one horizontal wires are embedded and their images will always be cast on the film with every exposure. The shadow of the joint falls between them so that accurate measurements are taken of the movements of the head in the fossa, using these lines as lines of orientation.

With this technique the contours of the articular fossa, the eminentia articularis, the condylar head, and the enveloping radiolucent synovial space are clearly demonstrated, and their normal relationship appraised with the joint closed, at rest, and open. The thinnest part of the meniscus is interposed between the anterosuperior articular surface of the condyle and the articular slope of the fossa. With the mouth closed the average width in an adult is 3 mm. directly above the condylar head, 2 mm. directly opposite the slope of the eminens in front, and 2·5 mm. posteriorly.

Increase in the normal width of the space between the condyle and fossa is presumed to indicate a chronic thickening of the inter-articular cartilage or perhaps a perforation of the disk. A decrease in width may follow a compression of the disk due to heavy loading by malocclusion or may be due to degenerative changes in the cartilage. Comparison must always be made of the joint spaces on both sides, as there may be a unilateral lesion (*Figs.* 6, 7).

Clear views are obtainable of the size, shape, and position of the condylar head, and it must be realized that there is a wide variation in the positional normality. A retroposed condyle in the closed joint does not necessarily reflect a pathological condition.

If the condylar head is relatively large and the fossa shallow, the head will adopt a low and more anterior position nearer the eminentia articularis: if the condyle is small, with a deep fossa, the head will assume a high location with the joint space narrowest in the superior segment.

The normal movement of the condylar head when the mouth is opened, is downwards and forward to lie directly below the eminens, but in cases of subluxation and slackness of the capsular ligament there will be excessive mobility with the condyle travelling beyond

the eminens. On the other hand, with an arthritic joint, mobility becomes limited and certainly never out of the fossa.

The solitary or individual radiographic exposure is undertaken for the examination and determination of pathological conditions, growth studies. In all cases the first step towards the interpretation of the radiographs is accurate tracing of the outlines of the joint.

Arthrosis of the temporomandibular joint is primarily a non-inflammatory disturbance of the normal function of this joint and serial

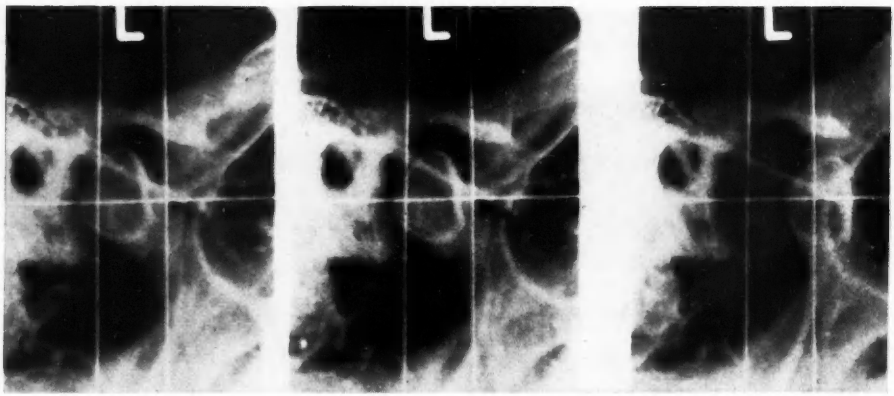

Fig. 6.—Position of joint. A, Closed; B, At rest; C, Open.

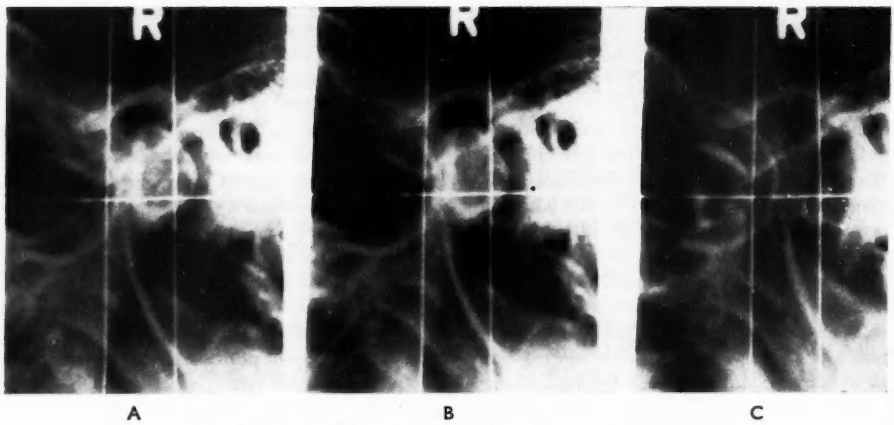

Fig. 7.—Position of joint. A, Closed; B, At rest; C, Open.

fractures of the neck of the condyle, and for anatomical features in connexion with the temporomandibular joint: multiple and repetitive exposures are necessary for functional records in oral reconstruction, prosthetic rehabilitation, orthodontic planning, and arthro-radiography is exceedingly important in these cases before therapy planning. Correction of jaw malposture provides relief of pain and other symptoms often related to stresses imposed by abnormal mandibular position.

In the field of research there is still much to be done. Is the joint a stress-bearing mechanism? What is the main pressure-bearing region of the joint? In what direction do the muscular forces exert their influence? Are mandibular position and functional range entirely controlled by the condyle–fossa relationship?

I have attempted to integrate many of the principles and methods so far in use, to design an apparatus and develop a technique which is simple, easy to operate, highly standardized, facile for duplication, and available for accurate measurement of the movements of the condylar head in the glenoid fossa. This method of investigation, together with electromyography, should help to verify that the mandibular position is, in fact, primarily under muscular control and regulated by neuromuscular reflexes. If this be confirmed, then mandibular position can be changed through muscle re-education, together with changing the position of the condyle.

I wish to record my indebtedness to the Board of Governors of St. George's Hospital, London, through whose assistance I was able to visit a number of dental centres in the U.S.A. and compare our collateral endeavours in the field of Dental Radiography; and specially to Professor Wm. Updegrave, of Temple University, Philadelphia, whose imaginative stimulation has resulted in my design of the foregoing apparatus with funds provided by St. George's Hospital.

Replantation of Individual Teeth

A tooth removed accidentally from its socket may be replanted providing neither the tooth nor the alveolus is fractured. Such teeth have been known to give up to ten years of useful service. They are eventually lost through root-resorption.

In the case reported the two maxillary centrals had been knocked out during a hockey match. Blood-clots were removed from the sockets, the teeth cleaned and sterilized in zepheran chloride followed by alcohol, and then placed in the sockets. Radiographs were taken followed by bite registration and alginate impressions.

The centrals were then removed and the root-canals cleaned and filled with silver points. Sterilization was again carried out and the teeth positioned in their sockets and checked with radiographs. The alginate impression was used to process an acrylic splint and this was cemented in place and left for five days. The patient was seen daily and the general condition, temperature, etc., noted. Nothing untoward was forthcoming and antibiotics were uncalled for. Finally a cast vitallium splint was left in place for six weeks. At this point mobility was very slight.—McGUIGAN, J. P. (1956), *J. Canad. dent. Ass.*, **22**, 294.

Correlation of Oral and General Diseases

The inter-relationships between general and oral diseases are manifold. The oral tissues, except enamel and dentine, differ very little from the other tissues of the body. Even enamel and dentine share in some metabolic processes as shown by the study of these tissues with radioactive isotopes. There is no doubt that oral sepsis affects general health, including malnutrition, and pain and oral deformities cause emotional disturbances affecting the well-being of the patient. The sensibility of the gingival tissues to systemic influences is well known. In both medicine and dentistry emphasis on the patient as a person has increased in recent years. The mouth has considerable emotional significance and is the site of many psychosomatic disturbances. Mental and emotional factors, operating in both dental practitioner and patient greatly affect the treatment of patients with dental and oral diseases. Medicine and dentistry share many diagnostic and therapeutic problems. The correlation of general and oral diseases depends on the co-operation between medical and dental practitioners as well as on the development of oral and dental medicine as a specialized branch of dentistry.—WALSH, J. P. (1956), *Int. Dent. J.*, **6**, 345.

AN INVESTIGATION INTO THE GLYCOGEN CONTENT OF THE GINGIVÆ*

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GLYCOGEN is a polysaccharide resembling starch in structure and in chemical properties. It is made up of twelve to eighteen glucose units joined together by alpha linkages. In the animal body glucose is converted into glycogen in the liver and muscles and is stored there until required, thereby being available as a source of energy. However, glycogen is found also in the epithelium of the vagina, skin, and gingivæ. It was thought that investigation of the glycogen content of the gingivæ at different periods of life, and in both sexes, might throw further light on the mechanism of œstrogen action on the gingival tissues.

Following some Japanese work, Cruickshank and Sharman in 1934 examined sections of the vagina at various stages of life. They found that in the fœtus and up till five days after birth there was abundant glycogen in the epithelium. From nine days to one month the glycogen became progressively less and the epithelium thinner, and it remained like this until puberty. With the onset of puberty the epithelium thickened again and the glycogen became abundant. It was not until the menopause that the epithelium again became thinner and the glycogen content scanty or even absent. They suggested therefore that the deposition of glycogen is dependent upon ovarian activity, that is, on the supply of the ovarian hormone, œstrin. Rakoff, Feo, and Goldstein (1944) went on to show that in late pregnancy, and in the later stages of the menstrual cycle, the vaginal epithelium is rich in glycogen, when the œstrogen level is at its highest. If, therefore, the glycogen content of the gingivæ shows variations in concentration at various ages, it would be a strong indication that œstrogens may act by altering the glycogen content of the gingivæ, which in turn may affect the structure of the gingival epithelium. The present study was therefore undertaken to see if this was a possibility. The presence of glycogen was also correlated with the type of keratinization found in the gingival epithelium and the underlying amount of inflammatory infiltration.

MATERIAL

Specimens of clinically normal gingivæ were obtained from patients requiring the extraction of one or two teeth whilst the abnormal gingivæ were from patients requiring gingivectomy. *Table I* shows the total number of gingival specimens examined and the number

Table I.—TOTAL NUMBER OF GINGIVAL SPECIMENS EXAMINED

	Males	*Females*
Children (0–11 yr.)	2	10
Adolescents (11–18 yr.)	4	7
Adults (18–40 yr.)	31	58
Adults (over 40 yr.)	12	16
	Total 140	

Table II.—NORMAL AND PATHOLOGICAL GINGIVÆ

	Normal		*Pathological*	
	Males	*Females*	*Males*	*Females*
Children	2	10	0	0
Adolescents	1	5	3	2
Adults	16	11	15	47
Adults (over 40 yr.)	9	13	3	3

in the various age groups, whilst *Table II* shows the number of abnormal and normal gingivæ in each group. The criteria for clinical normality was that the gingivæ should be firm, pink, and stippled, and the crevice should be 0–2 mm. in depth with no bleeding on examination with a blunt probe. All the gingival specimens were obtained by means of a knife; the electrosurgical unit was not used in any of the above cases in case charring or overheating of the specimen altered areas

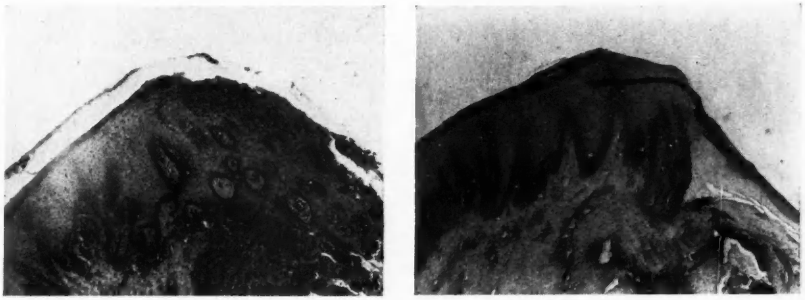
* Read at the meeting of the British Society of Periodontology held at the Eastman Dental Clinic on Monday, February 18, 1957.

to be examined microscopically. The gingival specimens were placed immediately in a 10 per cent formal saline fixative before being trimmed.

METHODS

It has usually been held that glycogen breaks down into its constituent carbohydrates very rapidly after removal of tissue from the body. Many fixation techniques have therefore been evolved to try to overcome this problem. Pearse (1953) points out that there are a large number of naturally occurring glycogens, and the larger molecules, showing a higher degree of polymerization, can be fixed by a variety of methods; whereas the less highly polymerized molecules are probably never successfully fixed, but diffuse out into the fixing fluid. Even so, when special fixatives are used, quite large amounts of glycogen can be lost in the subsequent staining processes. Vallance-Owens (1948) used three different types of fixatives on the livers of rabbits and came to the conclusion that formaldehyde is as efficient a fixative for glycogen as is absolute alcohol or Bouin's fluid. From these results it would appear that this fixative is quite efficient for the purposes of this study in giving some indication of the presence and distribution of the higher polymerized glycogen molecules in the gingivæ.

With regard to the staining techniques, here again many methods have been proposed. The periodic acid Schiff reaction of McManus (1946) and Hotchkiss (1948) was used for staining the polysaccharides. A wide variety of polysaccharides are stained by this method. Therefore to ascertain the specificity of the P.A.S. reaction, two slides of the same section are stained by this method. One section is treated with either saliva or diastase. This removes the glycogen and leaves the other polysaccharides, which are stained by the P.A.S. reaction. The two sections can then be compared, and it is easily seen which is the glycogen in the untreated section (*Fig.* 1 A, B).



A B

Fig. 1.—A, A section of gingivæ stained by the P.A.S. reaction showing glycogen in the epithelium. (× 39.) B, A comparable area of another section from the same gingival specimen as A, stained by the P.A.S. reaction and then treated with diastase to show removal of the glycogen. (× 39.)

The specimens were therefore placed directly into 10 per cent formal saline for fixation, trimmed, and embedded in paraffin wax. Sections were cut at 5–6 μ, one section being stained by hæmatoxylin and eosin and the other by the P.A.S. reaction. Control slides were taken from time to time to ascertain the specificity of the staining technique.

Glycogen appears in the P.A.S.-stained section as red or violet granules in the cytoplasm of the epithelial cells and in the interstices between the cells. Due to the method of fixation, polarization of the glycogen granules occurs in the epithelial cells. The effect is twofold; the granules in the cytoplasm of the cells tend to concentrate in that area of the cell closest to the basal layer and so give a triangular appearance to the concentration of the granules. Concomitantly, the granules in

the whole section appear as if they have been brushed to one side.

The trimmed specimens were embedded in such a way that a section showing the crevicular, crest, and surface epithelium of the marginal gingivæ could be examined. From these sections four facts were noted, two

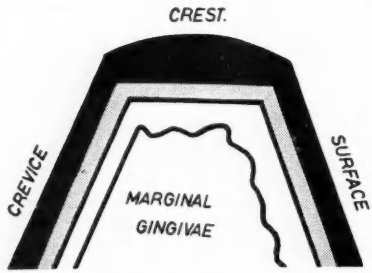


Fig. 2.—A diagram showing the method used to examine the crevicular, crest, and surface epithelium for glycogen.

from those stained by the P.A.S. reaction, and two from those stained by hæmatoxylin and eosin.

Firstly, the question of the amount of glycogen present. Histochemical methods are essentially qualitative and therefore it is possible to record only relatively gross alterations in quantities. Accordingly, the amount of deposition of the glycogen was noted as slight, moderate, or heavy in character. Naturally, such observations depend very greatly on the judgement of the observer, but with experience, it was felt that a reasonably accurate estimation can be made. Twenty-five sections examined at random on five different occasions showed that consistent results were being obtained.

Secondly, there is the distribution of the glycogen in the epithelium. The epithelium in each area was divided into thirds (*Fig.* 2): The outer third consisting of the upper part of the prickle-cell layer, the granular layer, when present, and the hornified layer; the middle third consisting of the middle part of the prickle-cell layer; whilst the lower third was the basal-cell layer and the first few rows of the prickle-cell layer.

Thirdly, there was the intensity of the inflammatory infiltration. This was noted as slight, moderate, or heavy in degree, the cells present being mainly small round cells and plasma cells.

Lastly, the type of keratinization found in the crevice, at the crest, and on the outer aspect of the marginal gingivæ was classified according to Castenfelt (1952). The intensity of the keratinization falls into three groups, non-keratinized, para-keratinized, and keratinized. Into which group the particular section will be classified depends upon the staining characteristics of the cytoplasm, the form and occurrence of the nuclei, and the form of the cells in the superficial aspects of the epithelium.

INVESTIGATION

Glycogen in Female Gingivæ.—Gingival biopsies were obtained from 84 female patients in the three main age groups of interest; 10 children, 58 adults, and 16 adults over the age of 40 years (*Table III*).

Table III.—Female Gingivæ examined for Glycogen

Children (0–11 yr.)	10
Adults (18–40 yr.)	58
Adults (over 40 yr.)	16
Total	84

Table IV.—Glycogen Deposition in Female Gingivæ

	Slight	*Moderate*	*Heavy*
Children			
Upper third	1	4	–
Middle third	1	4	–
Adults			
Upper third	19	12	1
Middle third	8	10	1
Adults over 40			
Upper third	4	3	2
Middle third	4	3	2

Table V.—Glycogen Deposition in Female Gingivæ

	Slight	*Moderate*	*Heavy*
Crest epithelium			
Upper third	19	12	1
Middle third	8	10	1
Lower third	1	—	–
Surface epithelium			
Upper third	8	5	2
Middle third	16	6	2
Lower third	3	2	–

The amount of glycogen deposited in the three age groups in the crest epithelium is shown in *Table IV*. It will be noticed that

glycogen was found in the gingivæ at all ages, and although no glycogen was observed in 2 of the female children it was also not seen in 16 of the adults between the ages of 18 and 40 years. From this it was considered that the deposition of glycogen in the gingivæ was not under direct œstrogenic control.

Fig. 3.—A section of normal crest epithelium stained by the P.A.S. reaction, from a girl aged 8 years. Notice the moderate amount of glycogen present in the middle and outer thirds of the epithelium. (× 66.)

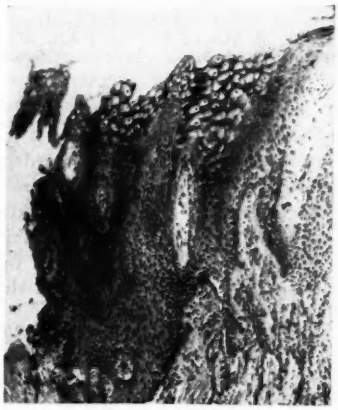


Fig. 5.—A section of pathological gingivæ from a woman aged 56, stained by the P.A.S. reaction. This shows quite heavy amounts of glycogen in the outer two-thirds of the crest epithelium. (× 66.)

Not only is the amount of glycogen of interest, but also its distribution. *Table V* shows that slight and moderate concentrations of glycogen were found mainly in the outer third of the gingival crest epithelium, whilst on the surface of the marginal gingivæ the same concentration was found mainly in the middle third of the epithelium. In fact, the distribution and concentration figures would appear to be mirror images of each other. Although *Table V* demonstrates the distribution of glycogen found in adult females between the ages of 18 and 40 years, a similar, but less marked distribution was also seen in the gingivæ of children and adults over 40 years of age (*Figs.* 3–6).

Fig. 4.—A section of pathological gingivæ showing the crest epithelium, from a woman aged 30. The section has been stained by the P.A.S. reaction and the glycogen is concentrated in the outer two-thirds of the epithelium. (× 66.)

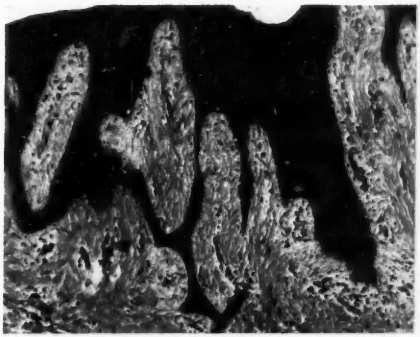


Fig. 6.—A section of the surface of the marginal epithelium from a woman aged 30, stained by the P.A.S. reaction, showing glycogen through the whole thickness of the epithelium. (× 66.)

Glycogen in Male Gingivæ.—Although the number of male gingivæ examined was not as

great as the female, enough cases were examined to be of significance, in comparing the deposition and distribution of gingival glycogen in the two sexes. The total number of male gingival specimens examined has already been shown, but *Table VI* shows the amount and distribution of glycogen found in 31 adult males between the ages of 18 and 40 years. Both the concentration and the distribution of glycogen is very similar to that found in the female gingivæ of the same age group. Similarly the gingival glycogen found in male children and adolescents, and in those over 40 years of age, was alike both in concentration and distribution with the corresponding age groups in females (*Figs.* 7–9).

Fig. 7.—A section of normal gingivæ from a boy aged 8 years, stained by the P.A.S. reaction, showing glycogen in the crest and crevicular epithelium. (× 66.)

Fig. 8.—A section of pathological gingivæ from a male aged 23, stained by the P.A.S. reaction. Glycogen is found through the whole thickness of the epithelium. (× 66.)

Fig. 9.—A section of pathological gingivæ from a male aged 47, stained by the P.A.S. reaction. This shows moderate amounts of glycogen in the outer two-thirds of the crest epithelium. (× 66.)

Glycogen related to Keratinization.—Cruickshank and Sharman (1934) not only showed the presence or absence of glycogen in the vagina, but also related it to the thickness of the epithelium and the degree of keratinization. It appeared that there was a direct relationship between the thickness of the epithelium, the type of keratinization found, and the amount of glycogen present. Papanicolaou (1933) has also shown that the cyclic pattern of the menstrual cycle can be demonstrated by desquamative cytological methods.

Table VI.—Glycogen Distribution in the Male Gingivæ

	Slight	*Moderate*	*Heavy*
Crest epithelium			
Upper third	11	5	1
Middle third	5	6	1
Lower third	—	–	–
Surface epithelium			
Upper third	4	3	–
Middle third	5	3	–
Lower third	4	3	–

There are two views with regard to the relationship between the type of keratinization

and the thickness of the vaginal epithelium, and the amount of glycogen that is present.

The earlier studies of Cruickshank and Sharman (1934), Davis and Pearl (1938) and Rakoff, Feo, and Goldstein (1944) all show that these writers believe that the deposition of glycogen in the vaginal epithelium is directly related to the œstrogen level. Thus greater amounts of glycogen are found during the active sexual phase of a woman's life than during childhood; and greater amounts are also observed near the end of pregnancy and the latter part of the menstrual cycle. However, Ayre (1951) suggested that the œstrogens act primarily as growth stimulants and cell differentiators, thus promoting a multi-layered vaginal epithelium, and that cells thus formed accumulate glycogen, as a consequence of their intrinsic metabolic activity. Thus the glycogen content will depend upon the thickness of the epithelium formed. Bradfield (1951) adds support to this view in a study of the healing of wounds in guinea-pigs. He found that while the epithelium was regenerating there was abundant glycogen function, but when the scabs separated fourteen days after the initial wound the glycogen content had diminished and could only be seen in isolated cells in the prickle-cell layer. Whichever of the two views may be the correct, there would seem to be some basis for considering that the presence of glycogen may be related to the degree of keratinization found in the vaginal epithelium, and this in turn may be related to œstrogen action.

Table VII.—Glycogen Deposition and Keratinization (Females)

	Crest Epithelium	*Surface Epithelium*
Slight	14	18
Non-keratinized	25	3
Moderate	15	8
Parakeratosis	24	28
Heavy	—	2
Keratinization	2	27

Table VII shows the deposition of glycogen and the degree of keratinization found in 58 adult females between the ages of 18 and 40 years, whilst *Table VIII* shows the same information about 31 adult males in the same age groups.

Two questions have to be asked: First, when there is increased keratinization is there also an increased or decreased deposition of glycogen? Secondly, if there is a decrease in the amount of keratinization, is there an increase or decrease in the amount of glycogen present?

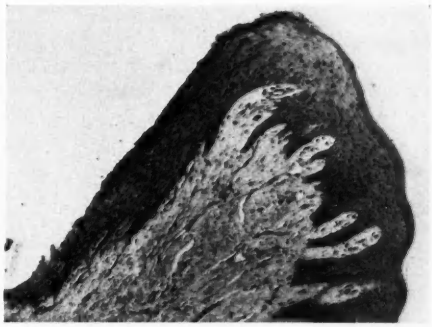


Fig. 10.—A section of normal gingivæ from a male aged 42, stained by the P.A.S. reaction, showing slight amounts of glycogen in the crevicular epithelium. (× 66.)

From these two tables it would appear that when there is normal keratinization present, there is no increase in the deposition of glycogen in the surface gingivæ. However, the author does not think that it is possible to say that when there is a lack of keratinization there is an increased deposition of glycogen, because the figures showing the results on the crest epithelium are similar to each other.

Table VIII.—Glycogen Deposition and Keratinization (Males)

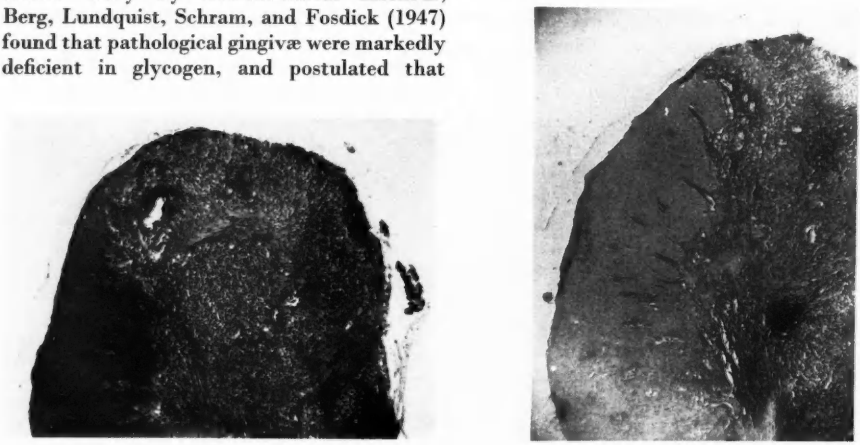
	Crest Epithelium	*Surface Epithelium*
Slight	5	8
Non-keratinized	12	1
Moderate	10	6
Parakeratosis	11	14
Heavy	2	—
Keratinization	3	16

Here the author would agree with Dewar (1955) that there is no apparent correlation between the degree of keratinization and the deposition of glycogen, but would differ from Dewar, who found no glycogen in the crevicular

epithelium; in the present series of 140 gingival biopsies glycogen was seen in slight quantities in 28 out of the 43 specimens which showed enough crevicular epithelium upon which comment could be made (*Fig.* 10).

Glycogen related to Inflammation.—In an earlier study by microchemical methods, Berg, Lundquist, Schram, and Fosdick (1947) found that pathological gingivæ were markedly deficient in glycogen, and postulated that since this substance is a source of sugar its absence would seem to promote protein breakdown and putrefaction. Thus glycogen may be a natural protective agent against protein degradation. Believing that glycogen depletion would allow a more rapid proteolytic breakdown in the periodontal tisues, Ostrom, Skillen, and Fosdick (1950) experimentally produced occlusal trauma in dogs. They failed to find any variation in the glycogen content of the control or experimental gingivæ. Turesky, Glickman, and Litwin (1951), comparing normal with inflamed gingivæ by histochemical means, found only scattered particles of glycogen in the normal, whilst in the chronically inflamed gingivæ the presence of glycogen appeared to be related to the underlying inflammation. Dewar (1955) came to the same conclusion and felt that the amount of glycogen present was proportional to the degree of the underlying inflammation. She suggests that the deposition of glycogen is dependent upon an excess of glucose diffusing into the epithelium as a result of the adjacent inflammation.

It was therefore decided to investigate the correlation between the deposition of glycogen in the epithelium and the inflammation in the corium. The degree of inflammation was graded as slight, moderate, or heavy, according to the extent of the infiltration by small round cells and plasma cells.



A B

Fig. 11.—A, A section of pathological gingivæ from a woman aged 45, stained with hæmatoxylin and eosin, showing a heavy round-celled infiltration of the corium. (× 39.) B, A section of gingivæ from the same patient, stained by the P.A.S. reaction, showing no glycogen in the epithelium. (× 39.)

Table IX shows the amount of glycogen present in the gingivæ from 58 women between the ages of 18 and 40 years. The deposition of glycogen in the crest and surface epithelium is shown and compared with the degree of inflammation. A heavy infiltration with small

Table IX.—Glycogen Deposition and Inflammatory Infiltration

	Slight	*Moderate*	*Heavy*
Crest epithelium			
Upper third	19	12	1
Middle third	8	10	1
Lower third	1	—	—
Surface epithelium			
Upper third	8	5	2
Middle third	16	6	2
Lower third	3	2	—
Inflammatory Infiltration	22	18	18

round cells and plasma cells was noted in 18 of these specimens, yet in only 6 was there a correspondingly large amount of glycogen deposited in the epithelium. Similar figures were found in all the other age groups examined. Further, if glycogen deposition is a protective reaction as suggested by Berg and others (1947), then heavy deposits would surely be expected in the non-keratinized crevicular epithelium. In the present series there was, however, no correlation between the glycogen deposition in the crevicular epithelium and the degree of inflammatory change in the adjacent connective tissue.

In general, one would expect to see fewer specimens containing glycogen in those showing slight inflammation, but this is not the case; it would appear that glycogen deposition is found in both clinically normal and chronically inflamed gingivæ and is unrelated to the degree of inflammatory infiltration (*Fig.* 11).

CONCLUSIONS

Although it is not possible by histochemical methods to measure accurately the glycogen content of the gingivæ, there is no doubt that the methods which have been employed in this investigation offer sufficient evidence for certain conclusions to be drawn.

In women it would appear that there is no correlation between the deposition of glycogen in the gingival epithelium and its deposition in the vaginal epithelium. In the vaginal epithelium it is deposited in close correlation with the sexual phases in a woman's life, the glycogen deposition varying from childhood until after the menopause. This would not appear to be the case in the gingivæ, and one may presume that glycogen deposition in this site is not influenced by œstrogen activity. This is further supported by the fact that there is no apparent difference in the glycogen distribution or concentration in either male or female gingivæ.

The hypothesis that glycogen is necessary for the production of keratin is also hard to substantiate. In those areas in which normal keratin is formed, glycogen is not present in any increased amount.

In the crest epithelium, where keratinization was often absent, glycogen was just as frequently present in quantities similar to the other areas. If glycogen is essential for keratin production, it is difficult to understand why it should ever be found in the crevicular epithelium, where it was quite often seen.

The degree of inflammatory infiltration was noted in all cases and there does not appear to be any relation between either the presence of glycogen or the concentration of glycogen and the degree of inflammation. Here the author would disagree with Dewar (1955) with regard to glucose diffusing into the epithelium from the inflammatory reaction and being stored as glycogen. Similarly, since glycogen was found in both clinically normal and pathological gingivæ in not dissimilar amounts or distribution, the hypothesis that it may serve a protective function to protein degradation is hard to substantiate.

It would seem that glycogen is present in the gingival epithelium for some as yet unknown process of cell metabolism and that the thickness of the epithelium or the degree of keratinization must depend on other factors.

SUMMARY

Histochemical studies for glycogen in 140 gingival biopsies showed no relationship between the presence, concentration, or distribution of this substance and age, sex, phase of sexual life in females, or inflammation.

Acknowledgements.—These investigations were carried out at the Royal Dental Hospital School of Dental Surgery of the University of London and I must thank the people involved for their help, particularly Professor R. B. Lucas, Mr. A. Bryan Wade, and Dr. Blackwood. For the slides and preparation of this paper, I must thank the Photographic and Periodontal Departments of the Eastman Dental Hospital.

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BOOK REVIEWS

ORAL CANCER AND TUMOURS OF THE JAWS. By G. S. SHARP, M.D., F.A.C.S., F.A.C.R. (Ther.); W. K. BULLOCK, M.D., M.Sc. (Path.), and J. W. HAZLET, D.D.S., University of Southern California. 9×6 in. Pp. 561 + xii, with numerous illustrations. 1956. New York and London: Blakiston Division, McGraw-Hill. 112s. 6d.

IN the preface the authors state that "this work is intended not as a textbook or reference guide on the management of cancer, but as a syllabus for the oral diagnostician—it is designed as a visual aid in the diagnosis of neoplasms". In this the authors have succeeded.

One half of the book details the authors' experience in the diagnosis and treatment of 1020 cases of carcinoma of the mouth. Carcinomata of the tongue, lips, etc., are excellently dealt with on a regional basis, together with a consideration of the benign lesions that are considered in the differential diagnosis.

The second half of the book ranges over almost the whole of oral pathology. No references are given to the views of other workers in the text, even on subjects in which the authors themselves do not claim to be experts. Thus justice is not done to many important controversial points. Gingivitis gravidarum is described in men as well as in women; two-thirds of adamantinomata are said to arise from follicular cysts and the gingivæ; and fibrous dysplasia covers such diverse lesions as ossifying fibroma and osteoma. Median cysts and nasopalatine cysts are described as separate entities, although no real distinction is made between them, except that the latter are located more distally.

It is a pity that there are no references in the text to the many fine illustrations, and that there are no photomicrographs in the book to support the histological appearances described.

Perhaps the writers have tried to cover too much for the sake of completeness, but it is a book that was well worth writing and is well worth reading. The text is clear and to the point. The pictures are of a very high standard and altogether the book is beautifully produced.

B. E. D.

A TEXTBOOK OF OPERATIVE DENTISTRY. By WILLIAM H. O. MCGEHEE, D.D.S., M.D., F.A.C.D.; HARRY A. TRUE, D.D.S., F.A.C.D., San Francisco; E. FRANK INSKIPP, B.S., D.D.S., F.A.C.D., San Francisco; and Contributors. Fourth edition 9×6¼ in. Pp. 720 + xxii, with 423 illustrations. 1956. New York and London: Blakiston Division, McGraw-Hill. 105s.

THE fourth edition of this standard work on operative dentistry has been greatly enlarged in order, as its authors state, to make it as comprehensive as possible. Indeed, it is rapidly assuming encyclopædic proportions.

Quite rightly, this edition includes several new chapters by well-known experts on the more modern techniques in dentistry and, if only for this, it is a book of considerable value to the progressive dentist. These particular sections deal with the hydrocolloid impression, vacuum investment, diamond and tungsten carbide instruments, as well as including a discussion of the Vacudent and Airbrasive. Every aspect of operative dentistry is covered

in considerable detail, leaving no aspect of cavity preparation or filling materials to the imagination or other text-books. Especially good is the description of the use of gold foil.

In common with most modern text-books there is much to criticize—in fact, more than in most. For this book is verbose in the extreme, containing long irrelevant passages of what can only be described as thoughts on the philosophy of dental practice.

Had not the reviewer met Dr. True at the College of Physicians and Surgeons where the latter is Professor of Operative Dentistry, he would have been at a loss to understand why so much of the material in the book was included. In that school, chairside assistants are trained alongside dental students. Consequently, this book reflects this combined teaching by including sections on chairside assistants, surgery procedure, and surgery planning. Further, there are long lists of the necessary instruments for every operative procedure which are totally unnecessary, except in the light of the belief that this is a manual of practice for the students of a particular school rather than students at large.

In view of the increasing specialization in dentistry and in text-books as a whole, it might possibly have been better had the authors left chapters dealing with root canal therapy and children's dentistry to those books concerned with these specialized subjects.

Notwithstanding these criticisms, this book is a veritable mine of dental information and teaching and should be of great value to those who read it.

D. D.

PROSTHETIC DENTISTRY. A Clinical Outline. By F. Winston Craddock, B.A., Dip. Ed., M.S.D., D.D.S. Professor of Prosthetic Dentistry, University of Otago Dental School, Dunedin, New Zealand. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 430, with 186 illustrations. 1956. London: Henry Kimpton. 36s.

The third edition of this book is a comprehensive volume describing with detail all stages from the pre-extraction era to the insertion of full dentures.

The section on partial dentures is a little thin, and no consideration is given to stress broken free-end saddle cases where the anterior teeth, acting as retainers, are relieved almost entirely of the stresses and strains of occlusion and mastication.

Figures 59 and 60 show two successive stages in a case, but they must in fact be different cases as the face-bow has become inverted in Figure 60 relative to Figure 59. This tends to be confusing.

However, the general presentation of the volume is good, and it contains a wealth of readable material.

R. V. P. C.

CLINICAL ENDODONTICS. A Manual of Scientific Endontics. By Ralph F. Sommer, D.D.S., M.S., F.A.C.D., F.A.A.O.R.; F. Darl Ostrander, A.B., D.D.S., M.S., F.A.C.D.; and Mary C. Crowley, A.B., M.S.P.H., from the School of Dentistry and W. K. Kellogg Foundation Institute, Graduate and Post-graduate Dentistry University of Michigan. $9\frac{1}{4} \times 6\frac{1}{2}$ in. Pp. 514 + xviii, with 384 illustrations. 1956. London: Saunders. 72s. 6d.

The authors state that this volume was written to serve as a visual teaching aid and a practical reference guide. These aims have been fulfilled admirably. In the compass of its 514 pages, virtually every aspect of root canal therapy is covered in a logical and concise manner. The chapters dealing with the treatment of multi-rooted teeth and the detailed bacteriology of endodontics are especially instructive, whilst many will find useful the suggestions on prescriptions and formulæ, and restorations for pulpless teeth. Most workers will also concur with the conclusions drawn from a separate section devoted to discussing the limitations of the radiograph in the diagnosis of periapical lesions. A criticism is that the standard of some of the radiographs in the early chapters falls far behind that of the text; whilst many will disagree with the use of peridental injections for pulpal anæsthesia, and cotton-wool pledgets moistened with phenol for wiping away debris after pulpotomy.

However, these are minor criticisms of an otherwise excellent volume, which will well repay study by anybody seriously interested in endodontia.

E. N.

A SYSTEM OF ENDODONTIA. For the General Dental Practitioner. By DR. L. CASTAGNOLA, Lecturer at the University of Zürich; and H. G. ORLAY, F.D.S. R.C.S. (Eng.). 9 × 6 in. Pp. 143 + xiv, with 86 illustrations. 1956. London: Pitman Medical Publishing Co. Ltd. 45s.

THE practice of endodontia in this country has admittedly been very much neglected in the past. The reasons for this are numerous, not the least being the reluctance of the average patient to undergo the tedious and very often painful procedures associated with "taking out the nerve". The profession cannot be entirely blamed therefore if teeth have been extracted which could quite often have been saved by root-canal therapy. The combined effect of the "focal infection" bogy and the generally poor standard of tuition in the British Medical Schools up to 1939, made many dentists reluctant to embark on any but the very simplest of endodontic procedures. Since the war, teachers in the schools have made very great efforts to raise the standard of teaching to a level comparable with that existing in foreign schools. Certain methods of procedure have been standardized in most schools, one of the cardinal rules being the application of rubber dam under all circumstances. It is disappointing therefore to read in Castagnola and Orlay's new book that this vitally important step, while thought desirable, is not considered essential. A passing reference only is made to bacteriological control as being only suitable for "schools and hospitals, etc., and in places where scientific investigations are conducted". Their approach to root-canal treatment is entirely empirical, being based on the supposition that the injection of an antiseptic resorbable paste through the apex of a tooth is sufficient guarantee of permanent elimination of even the grossest infection. A chapter is devoted to "Mortal Amputation" involving the use of an arsenical devitalizing paste. The use of protoplasmic poisons in root therapy is no longer considered valid in British Dental Schools and although the authors stress the need for great caution, such methods cannot be condoned.

The chapters on instruments and radiography are clear and well illustrated, as is the chapter on vital pulp therapy. The role of calcium in the laying down of calcific repair tissue is not yet understood, as the authors state, and it is certainly not true that it is essential to use Calxyl to ensure a successful result.

Much of the material in this book is of a controversial nature. It is essentially a book for use of experienced practitioners who are interested in a particular technique, i.e. the so-called Walkhoff method. The newly qualified and less experienced would be well advised to read it with caution and in conjunction with a more comprehensive and orthodox book on the subject.

D. F. S.

LETTER TO THE EDITOR

February 12, 1957

Dear Sir,

There may be, amongst the readers of your excellent publication, some who would be interested in the following tip.

As a keen advocate of the regular use of dental sticks I find that a lot of patients tend to neglect their regular use because there is not a suitable simple carrier for these to be put in the pocket. I have found that if the expended paper cartridge and cartridge container is removed from a Benzedrine inhaler, the case then makes an ideal discreet carrier for about 20 wooden sticks, and it has been my experience that such a convenient case has improved the enthusiasm of patients for this type of dental oral hygiene.

Yours faithfully,

R. MILLER YARDLEY.

24 *Bore Street*,
Lichfield,
Staffs.